Appendix 4

8-Hour Ozone Modeling Analysis and Attainment Demonstration For South Carolina's Early Action Compact

Technical Support Document Executive Summary

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INTRODUCTION

The South Carolina 8-hour ozone modeling study was initiated in January 2000 and was designed to provide technical information relevant to attainment of an 8-hour National Ambient Air Quality Standard (NAAQS) for ozone in South Carolina, with emphasis on the Anderson/Greenville/Spartanburg, Aiken/Augusta, Columbia, Florence/Darlington, and Rock Hill areas.

The United States Environmental Protection Agency (EPA) has provided an option for areas currently meeting the 1-hour ozone standard, like those in South Carolina, to attain the 8-hour ozone standard by December 31, 2007, and obtain cleaner air sooner than federally mandated. This option offers a more expeditious time line for achieving emissions reductions than expected under the EPA's 8-hour ozone implementation rulemaking, while providing "fail-safe" provisions for the area to revert to the traditional State Implementation Plan (SIP) process if specific milestones are not met. Through the development of this Early Action Compact (EAC), local, state, and EPA agree to work together to develop and implement local and state early action plans. Based on the modeling results, portions of the plans may become a part of the state early action SIP to reduce ground-level ozone concentrations to comply with the 8-hour ozone standard by December 31, 2007, and maintain the standard beyond that date. Failure to meet the obligations outlined in this EAC will result in immediate reversion to the traditional non-attainment designation process as required in the Clean Air Act (CAA).

South Carolina has chosen to take part in the Early Action Compact. This report summarizes the methods and results of the photochemical modeling application for South Carolina. The modeling effort included the application of the variable-grid Urban Airshed Model (UAM-V) photochemical modeling system for one multi-day simulation period, evaluation of model performance, and use of the modeling system to estimate ozone concentrations for 2007, 2012, and 2017.

MODELING OVERVIEW

The South Carolina modeling analysis was designed in accordance with draft EPA guidance (EPA, 1999a) for using modeling and other analyses for 8-hour ozone attainment demonstration purposes. The modeling analysis components include a comprehensive episode selection analysis to identifying suitable periods for modeling, application and evaluation of a photochemical modeling system for one multi-day simulation period, projection of emissions and ozone concentrations for this simulation period in 2007 and 2012, and evaluation of the effects of various emissions reduction scenarios on future-year ozone air quality. While photochemical modeling is currently the best available and most widely used technique for estimating the effects of emission changes on future-year ozone levels and for evaluating attainment strategies, EPA also recommends that additional analysis of observed data be included as part of an attainment demonstration. Thus it is anticipated that future efforts will also include the analysis of observed data to corroborate the results and conclusions of the modeling analysis.

The primary modeling tools selected for use in this study include: the variable-grid Urban Airshed Model (UAM-V) Version 1.31, a regional- and urban-scale, nested-grid photochemical model; the Emission Preprocessor System (EPS2.5), for preparation of model ready emission inventories; the Biogenic Emission Inventory System with 4km resolution land-crop data (BEIS-2+), for estimating biogenic emissions; the MOBILE6 model, for estimating motor-vehicle emissions; and the Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Model, Version 5 (MM5), for preparation of the meteorological inputs. The UAM-V modeling system outputs were summarized and displayed using the UAM-V Postprocessing System (UPS) and the SC DHEC ACCESS Database for Visualizing and Investigating Strategies for Ozone Reduction (ADVISOR).

The modeling domain for application of the UAM-V was designed to accommodate both regional and subregional influences as well as to provide a detailed representation of the emissions, meteorological fields, and ozone (and precursor) concentration patterns over the area of interest. The UAM-V modeling domain includes a 36-km resolution outer grid encompassing the southeastern U.S; a 12-km resolution intermediate grid; and a 4-km resolution inner grid encompassing South Carolina and portions of Georgia, Tennessee, and North Carolina.

As ozone episode during the 16 – 23 May 1998 time period provides the basis for modeling for all four areas, for the objectives of capturing multiple high ozone days and some different wind directions for the South Carolina monitoring sites. The key modeling days are 18 – 22 May. The episode provides a good episode for modeling because several different areas of the state are affected, thus allowing an evaluation of the emissions inventory as well as the ability of the modeling system to replicate the observed ozone concentration patterns and levels. The results of the methodology used for this analysis were backed by results from a related study done for the Augusta area in neighboring Georgia.

Emissions

The modeling inventories for the episode were prepared based on the following information:

- 1996 National Emissions Trend (NET) Version 3 emission inventory.

- Emissions data provided by states for specific years.

- Episode-specific emissions data provided by individual facilities.

The 1996 NET inventory includes annual and ozone season daily emissions for oxides of nitrogen (NO_x), volatile organic compounds (VOC), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter with a diameter less than 10 and 2.5 microns (PM_{10} and $PM_{2.5}$), and ammonia (NH_3). Since the modeling inventories were prepared for use in

ozone modeling applications, the ozone season daily emissions of NO_x, VOC, and CO from NET 96 were used for the modeling analysis.

To facilitate development of the detailed emission inventories required for photochemical modeling for this analysis, the UAM Emission Preprocessor System, Version 2.5 (EPS 2.5) was used. This system, developed by SAI, consists of series of computer programs designed to perform the intensive data manipulation necessary to adapt a county-level annual or seasonal emission inventory for modeling use. EPS 2.5 provides the capabilities, and allows for the evaluation of proposed control measures for meeting Reasonable Further Progress (RFP) regulations and special study concerns.

Meteorology

The UAM-V photochemical model requires hourly, gridded input fields of wind, temperature, water-vapor concentration, pressure, vertical exchange coefficients (K_v), cloud cover, and rainfall rate. These meteorological inputs were prepared for the South Carolina UAM-V application using the Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Model, Version 5 (MM5).

The meteorological modeling consisted of an initial application of the MM5 modeling system and two additional simulations using revised input parameters or application procedures. The meteorological modeling was a part of the overall UAM-V diagnostic analysis.

Boundary Conditions

The primary reason for using a nested-grid, regional-scale modeling configuration is to reduce the effects of uncertainty in the boundary conditions on the simulation results for the area of interest. Lateral boundary conditions need only be specified for the outermost (coarse-grid) domain. Top boundary conditions are specified for all domains using a single set of values. For this study, the lateral and top boundary concentrations for all pollutants were initially set equal to the values listed below. These were assumed to be representative of continental-scale background values. The initial values are: 40 ppb for ozone; 1 ppb for NO_x (0 ppb for NO, 1 ppb for NO_2); 25 ppb of hydrocarbons, divided among the lumped hydrocarbon species according to the default CB-IV speciation profile as given in EPA (1991); and 200 ppb of CO. After the initial base case simulation, it was decided to increase the initial ozone value first to 55 ppb and later to 60 ppb. This decision came out of evaluation of the calculated ozone value for the remaining simulation days. In this manner, regional-scale build-up and/or lowering of ozone concentrations is represented in the simulations. The ozone boundary condition values for each day of the simulation period are listed in Table ES-1. Note that the values given in this table are for the base-case simulation.

Table ES-1.
Ozone concentrations used as boundary conditions for the base-case simulations,
as calculated using the self-generating ozone boundary condition technique.

Date	Boundary Ozone (ppb)
5/16/98	60.00
5/17/98	58.03
5/18/98	61.31
5/19/98	63.78
5/20/98	66.15
5/21/98	67.14
5/22/98	65.76
5/23/98	64.87

BASECASE MODELING

The first stage in the application of the UAM-V modeling system for ozone air quality assessment purposes consists of an initial simulation and a series of diagnostic and sensitivity simulations. These simulations are aimed at examining the effects of uncertainties in the inputs on the simulation results, identifying deficiencies in the inputs, and investigating the sensitivity of the modeling system to changes in the inputs. Model performance for each simulation is assessed through graphical and statistical comparison of the simulated pollutant concentrations with the observed data obtained from available monitoring stations located throughout the domain. The results of this comparison are used to assess whether the model is able to adequately replicate the air quality characteristics of the simulation period and to determine whether additional diagnostic and sensitivity simulations are needed.

The base-case modeling analysis results indicate that the MM5/UAM-V modeling system can be used to successfully simulate the ozone concentration levels and patterns that occurred within South Carolina during the unique processes leading to high ozone along South Carolina. Key findings related to model performance include:

- Model performance varies by day, and within sub-regions

- Statistical measures for all domains (Grids 1, 2 and 3) are generally within the EPA recommended ranges

- There is no consistent bias toward over- or underestimation (1-hour and 8-hour) on a domain-wide or site-specific basis. However, observed peaks are underestimated at many sites for 18-20 May. The reason may be that precursor emissions (CO and VOC emissions) from wildfires in Central America influenced the ozone levels on these days but are not represented in the simulation. Diagnostics analysis seems to support this theory.

- Changes to the UAM-V inputs (emissions, meteorological, initial and boundary conditions) produce expected (and moderate) responses

Model performance for South Carolina is consistent with that for Georgia and North Carolina, which indicates that the modeling emission inventories developed for the first time for South Carolina are of comparable quality to those for the neighboring states, which have been used and refined extensively for the purposes of air quality modeling.

Table ES-2a

Summary of model performance metrics and statistics for 1-hour ozone for the 36 km UAM-V modeling domain (Grid 1): base-case simulation. Shading indicates that the calculated statistical measure is outside the EPA recommended range for acceptable model performance.

Simulation Day	Maximum Observed Ozone (ppb)	Maximum Simulated Ozone (ppb)	Mean Observed Ozone (ppb)	Mean Simulated Ozone (ppb)	Unpaired Accuracy of the Peak (%)	Average Accuracy of the Peak (%)	Normalized Bias (%)	Normalized Gross Error (%)	RMS Error (ppb)
980516	123	117.0	64.0	48.8	-4.9	-12.0	-21.0	32.0	27.7
980517	118	127.9	63.1	55.5	8.4	-11.7	-10.6	20.7	15.9
980518	124	130.8	68.9	58.1	-17.8	-14.8	-13.3	21.9	18.9
980519	146	149.6	73.5	64.0	2.5	-14.0	-11.0	19.0	17.5
980520	137	143.3	71.0	62.1	4.6	-15.6	-9.4	20.8	18.8
980521	120	129.8	66.1	62.6	-3.9	-4.4	-2.5	18.1	14.5
980522	132	132.5	59.2	55.5	0.4	-1.7	-3.7	20.2	15.2
980523	98	118.3	53.0	55.7	-3.8	8.3	6.7	20.1	13.2

Table ES-2b

Summary of model performance metrics and statistics for 1-hour ozone for the 12 km UAM-V modeling domain (Grid 2): base-case simulation. Shading indicates that the calculated statistical measure is outside the EPA recommended range for acceptable model performance.

Simulation Day	Maximum Observed Ozone (ppb)	Maximum Simulated Ozone (ppb)	Mean Observed Ozone (ppb)	Mean Simulated Ozone (ppb)	Unpaired Accuracy of the Peak (%)	Average Accuracy of the Peak (%)	Normalized Bias (%)	Normalized Gross Error (%)	RMS Error (ppb)
980516	123	117.0	65.2	54.8	-4.9	-5.8	-13.1	26.9	22.0
980517	118	127.9	62.6	57.4	8.4	-8.7	-6.3	20.6	15.9
980518	124	130.8	70.2	58.4	5.4	-15.6	-14.4	22.3	19.2
980519	146	149.6	76.4	64.2	2.5	-17.0	-13.7	19.8	18.6
980520	137	143.3	72.4	65.2	4.6	-12.9	-6.9	19.2	17.6
980521	120	129.8	68.3	64.8	8.1	-6.2	-3.0	16.3	13.7
980522	132	132.5	59.1	58.0	0.4	-1.3	0.3	19.2	13.9
980523	98	118.3	53.5	59.7	20.7	13.4	13.3	20.9	13.8

Table ES6-2c
Summary of model performance metrics and statistics for 1-hour ozone for the 4 km SCDHEC UAM-V modeling subdomain (Grid 3): base-case simulation. Shading indicates that the calculated statistical measure is outside the EPA recommended range for acceptable model performance.

Simulation Day	Maximum Observed Ozone (ppb)	Maximum Simulated Ozone (ppb)	Mean Observed Ozone (ppb)	Mean Simulated Ozone (ppb)	Unpaired Accuracy of the Peak (%)	Average Accuracy of the Peak (%)	Normalized Bias (%)	Normalized Gross Error (%)	RMS Error (ppb)
980516	123	117.0	65.5	57.6	-4.9	-5.4	-8.7	23.8	19.6
980517	118	127.9	62.9	60.6	8.4	-4.8	-0.7	22.3	17.1
980518	124	130.8	71.6	59.3	5.4	-16.0	-14.1	23.0	20.0
980519	146	149.6	76.7	63.7	2.5	-16.9	-14.6	20.9	19.7
980520	122	143.3	74.5	66.9	17.5	-12.1	-7.5	18.7	17.0
980521	116	129.8	69.3	66.6	11.9	-6.4	-1.6	15.8	13.1
980522	132	132.5	61.7	60.6	0.4	-2.3	1.1	20.1	14.9
980523	98	118.3	55.7	63.2	20.7	15.1	15.8	21.7	14.7

Table ES-3a
Summary of model performance metrics and statistics for 8-hour ozone for the 36 km UAM-V modeling domain (Grid 1): base-case simulation.

Simulation Day	Maximum Observed Ozone (ppb)	Maximum Simulated Ozone (ppb)	Mean Observed Ozone (ppb)	Mean Simulated Ozone (ppb)
980516	107.6	98.4	61.7	48.5
980517	96.4	110.0	60.8	55.9
980518	123.5	116.5	65.2	57.5
980519	125.1	122.2	71.3	64.0
980520	122.8	123.7	69.4	62.4
980521	107.3	114.6	64.4	63.2
980522	103.9	112.5	57.9	56.1
980523	88.3	107.8	51.8	56.2

Table ES-3b
Summary of model performance metrics and statistics for 8-hour ozone for the 12 km UAM-V modeling domain (Grid 2): base-case simulation.

Simulation Day	Maximum Observed Ozone (ppb)	Maximum Simulated Ozone (ppb)	Mean Observed Ozone (ppb)	Mean Simulated Ozone (ppb)
980516	107.6	98.4	62.6	53.7
980517	96.4	110.0	60.4	57.7
980518	110.8	116.5	66.5	57.5
980519	125.1	122.2	74.0	63.8
980520	116.6	123.7	71.0	65.4
980521	104.3	114.6	66.7	65.3
980522	103.9	112.5	57.4	58.5
980523	76.8	107.8	51.9	59.6

Table ES-3c
Summary of model performance metrics and statistics for 8-hour ozone for the 4 km SDCHEC UAM-V modeling subdomain (Grid 3): base-case simulation.

Simulation Day	Maximum Observed Ozone (ppb)	Maximum Simulated Ozone (ppb)	Mean Observed Ozone (ppb)	Mean Simulated Ozone (ppb)
980516	107.6	98.4	62.7	56.7
980517	96.4	110.0	61.0	60.6
980518	108.6	116.5	68.3	58.0
980519	125.1	122.2	74.6	63.5
980520	105.8	123.7	73.1	67.1
980521	104.3	114.6	68.1	67.4
980522	103.9	112.5	59.6	60.9
980523	76.8	107.8	53.9	63.3

Table ES-3d
Site-specific average accuracy of the 8-hour peak ozone concentration (%) for selected sites in Grid 3.

Site	9-Cell Site-Specific Average Accuracy of the 8-Hour Ozone Peak (%)
Atlanta Area - GA	
Dawson Co., GA	14.4
Dawsonville, GA	14.4
So. Dekalb, GA	?
Tucker, GA	-5.2
Douglasville, GA	-5.3

Site	9-Cell Site-Specific Average Accuracy of the 8-Hour Ozone Peak (%)
Fannin Co., GA	-0.4
Fayetteville, GA	-6.9
Confederate, GA	-14.7
Lawrenceville, GA	-6.0
Yorkville, GA	-3.1
Conyers, GA	-8.0
Charlotte Area - NC	
Charlotte Lakedell, NC	-13.1
Mecklenburg Cty, NC	-8.7
Mecklenburg Cab C, NC	-16.2
Raleigh-Durham Area - NC	
Durham, NC	-2.5
Wake Cty, NC	-1.0
Raleigh, NC	-4.1
Fuquay-Varina, NC	-7.9
Garner, NC	-2.4
Anderson/Greenville/Spartanburg Area - SC	
Due West, SC	-2.8
Powdersville, SC	-10.5
Cowpens, SC	-9.0
Long Creek, SC	13.0
Clemson, SC	-2.9
North Spartanburg FS, SC	-6.8
Delta, SC	28.7
Rock Hill Area - SC	
Chester, SC	-11.7
York, SC	-7.7
Columbia Area - SC	
Parklane, SC	1.2
Sandhill, SC	-6.7
Congaree Swamp, SC	11.6
Aiken/Augusta Area - SC	
Jackson, SC	-3.7
Barnwell, SC	-9.2
Trenton, SC	-0.9
Augusta, GA	2.2
Florence/Darlington Area - SC	
Pee Dee, SC	-11.7
Indiantown, SC	4.5
Coastal Sites - SC	
Bushy Park, SC	4.2
Army Reserve, SC	9.1

Site	9-Cell Site-Specific Average Accuracy of the 8-Hour Ozone Peak (%)
Cape Romain, SC	59.2
Ashton, SC	-19.1

FUTURE YEAR MODELING

The SC DHEC modeling analysis included the application of the UAM-V modeling system for future years of 2007, 2012, and 2017. A future year modeling analysis of 2017 is included to provide an indication of the impact of the Early Action Compact process on future year ozone levels. This section presents the preparation of the future-year emission inventories and the results of the future-year modeling exercise.

The 2007, 2012, and 2017 future-year baseline simulations incorporate the effects of population and industry growth, technology changes, and national or statewide control measures that are expected to be in place by 2007, 2012, or 2017, depending on the simulation. These controls include VOC content limits for consumer solvents, Title III MACT assumptions, Title I RACT assumptions, VOC and CO reductions from residential wood combustion, onboard vapor recovery, Stage II controls at gas stations (as applicable), the NO_x SIP call, and Tier 2 low sulfur fuels. For the South Carolina subdomain (Grid 3), projection of emissions to 2007 result in approximate decreases of 38% and 17%, respectively, of anthropogenic NO_x and VOC, and about a 3% reduction in total VOC. Projection of emissions to 2012 result in approximate decreases of 38% and 18%, respectively, of anthropogenic NO_x and VOC, and about a 3% reduction in total VOC, as compared to the 1998 base case. For 2017, projection of emissions result in approximate decreases of 39% and 19%, respectively, of anthropogenic NO_x and VOC, and about a 3% reduction in total VOC, as compared to the 1998 base case.

ATTAINMENT TEST

For a monitoring site to pass the attainment test, its future-year estimated design value must not exceed 84 ppb. Future-year estimated design values (EDVs) are calculated for each site, for each simulated day, using "current-year" design values and relative reduction factors (RRFs) derived from future-year and base-year modeling results. The current-year design value for a given site is the three-year average of the annual fourth highest measured 8-hour ozone concentration. The RRF is the ratio of future- to base-year 8-hour maximum ozone concentrations in the vicinity of that monitoring site. The EDV is obtained by multiplying the current-year design value by the RRF.

Maximum current and estimated design values for the nonattainment sites in South Carolina are given in Table ES-4. This table shows the calculations of the relative reduction factors for 2007, 2012, and 2017. For the Anderson/Greenville/Spartanburg nonattainment area, these sites are the Powdersville monitor located in Anderson County

and the North Spartanburg Fire Station monitor located in Spartanburg County. For the Columbia nonattainment area this site is the Sandhill monitor located in Richland County. The EDVs were calculated using the 2007, 2012, and 2017 future year baselines as the bases for calculation of the RRF. For all sites, the EDV for 2007 is lower than the 1997-1999 DV, and the EDV for 2012 is lower than both the 1997-1999 DV and the EDV for 2007. For 2017, the EDV is lower than the EDV for 2012 for all sites except for Cape Romain. In addition, the values for all sites are less than or equal to 84 ppb. The 2001-2003 design value for these sites is also included in the table; the 2001-2003 design value was the data used to determine South Carolina's 8-hour ozone attainment status.

Table ES-4a.
Simulated current and future year 8-hour ozone concentrations for the Powdersville (Anderson County) site for the Anderson/Greenville/Spartanburg area.

Simulation Date	Simulated Maximum 8-Hour Ozone (ppb)			
	1998	2007	2012	2017
5/18/98	79	68	69	68
5/19/98	76	68	63	60
5/20/98	82	69	65	63
5/21/98	71	60	59	59
5/22/98	72	65	63	62
5/23/98	70	66	61	58
Average	75	66	63	61
EDV Calculations				
RRF		0.88	0.84	0.81
1997-1999 DV		96	96	96
2001-2003 DV		86	86	86
EDV (1999)		84	81	78

Table ES-4b.
Simulated current and future year 8-hour ozone concentrations for the North Spartanburg Fire Station (Spartanburg County) site for the Anderson/Greenville/Spartanburg area.

Simulation Date	Simulated Maximum 8-Hour Ozone (ppb)			
	1998	2007	2012	2017
5/18/98	78	69	69	69
5/19/98	77	66	64	64
5/20/98	82	70	67	66
5/21/98	76	64	63	62
5/22/98	74	70	68	67
5/23/98	72	67	65	65
Average	76	67	66	65
EDV Calculations				
RRF		0.88	0.87	0.86
1997-1999 DV		93	93	93
2001-2003 DV		87	87	87
EDV (1999)		82	81	80

Table ES-4c.
Simulated current and future year 8-hour ozone concentrations for the Sandhill (Richland County) site for the Columbia area.

Simulation Date	Simulated Maximum 8-Hour Ozone (ppb)			
	1998	2007	2012	2017
5/18/98	60^{1}	60^{1}	58^{1}	58^{1}
5/19/98	90	77	74	73
5/20/98	81	69	66	64
5/21/98	78	65	63	62
5/22/98	81	68	66	66
5/23/98	73	72	71	70
Average	80	70	68	67
EDV Calculations				
RRF		0.88	0.85	0.84
1997-1999 DV		91	91	91
2001-2003 DV		88	88	88
EDV (1999)		80	77	76

[1] Since the 5/18/98 maximum ozone concentration is less than 70 ppb, this day's ozone concentrations are not used in the calculation of the RRF.

Application of the modeled attainment test indicates that:

- The average estimated design value (EDV) for 2007 is approximately 10 ppb lower than the 1997-1999 observation-based design value. The average EDV for 2012 is approximately 13 ppb lower than the 1997-1999 observation-based design value. The average EDV for 2017 is approximately 16 ppb lower than the 1997-1999 observation-based design value.

- 2007, 2012, and 2017 EDVs for all sites are less than or equal to 84 ppb.

- The attainment test is passed for all sites for the 2007, 2012, and 2017 scenarios.

Sensitivity Analyses

The 2007 future-year baseline simulation was used as the basis for emissions-based sensitivity simulations. The sensitivity runs modeled changes in anthropogenic NO_x and VOC emissions to assess the modeling system's sensitivity to changes in emissions. SCDHEC performed eight sensitivity runs consisting of the following:

- 15 percent reduction in NO_x emissions

- 35 percent reduction in NO_x emissions

- 15 percent reduction in VOC emissions

- 35 percent reduction in VOC emissions

- 15 percent reduction in both NO_x and VOC emissions

- 35 percent reduction in both NO_x and VOC emissions

- 35 percent reduction in NO_x emissions, 15 percent reduction in VOC emissions

- 15 percent reduction in NO_x emissions, 35 percent reduction in VOC emissions

The estimated design values for selected runs are shown in Figure ES-5. This figure includes the three monitors that indicate non attainment according to 2001 – 2003 monitor data along with estimated design values for selected sites across South Carolina.

The VOC reduction sensitivity runs indicate the model is relatively insensitive to changes in VOC emissions. Some areas of the state show no change in design value due to VOC reductions while other areas show slight reductions due to reductions in anthropogenic VOC emissions.

The NO_x reduction sensitivity runs indicate the model is sensitive to changes in NO_x emissions. Increasing NO_x reductions produce lower estimated design values. As such, the sensitivity runs indicate South Carolina is NO_x limited for ozone production.

The combined NO_x/VOC emissions reduction runs indicate no additive or synergistic effects due to reductions in both NO_x and VOCs. The estimated design values that occur on the NO_x/VOC emissions reduction runs mirror the estimated design values caused by NO_x reductions. There are isolated cases of ozone disbenefits occurring due to combined NO_x and VOC reductions.
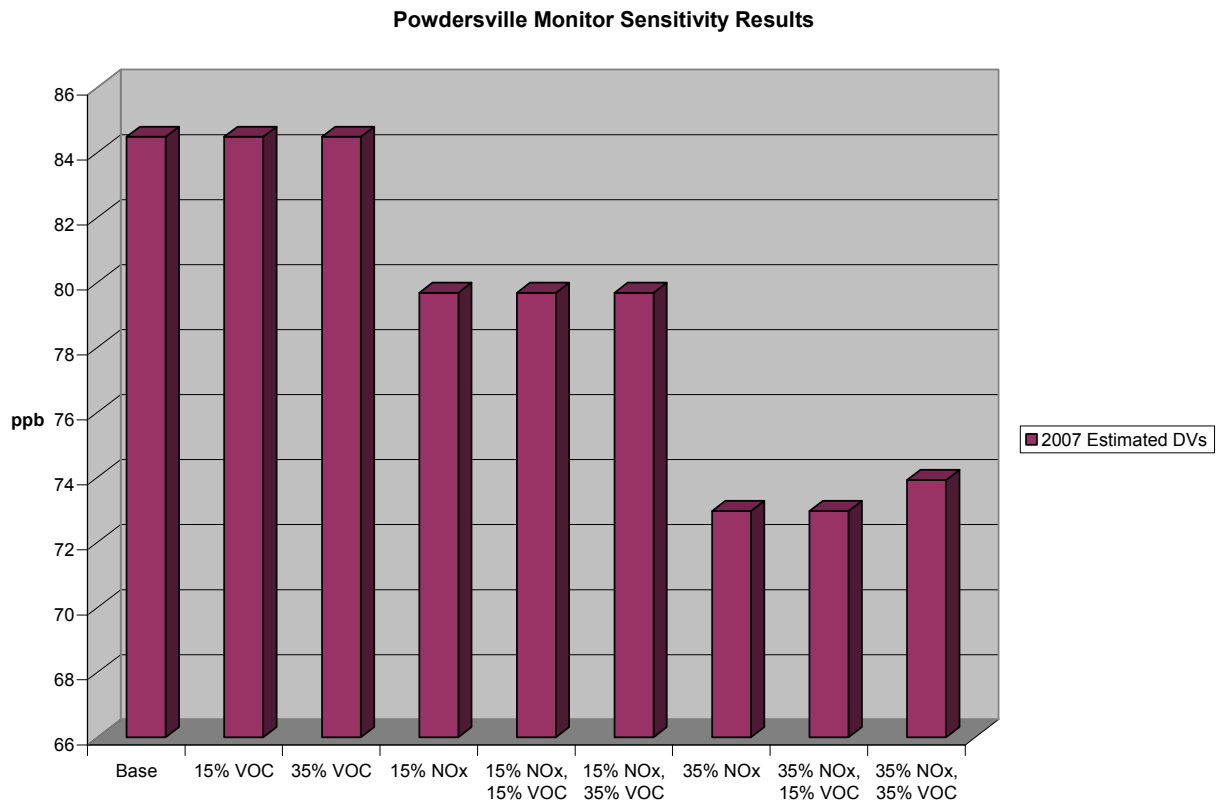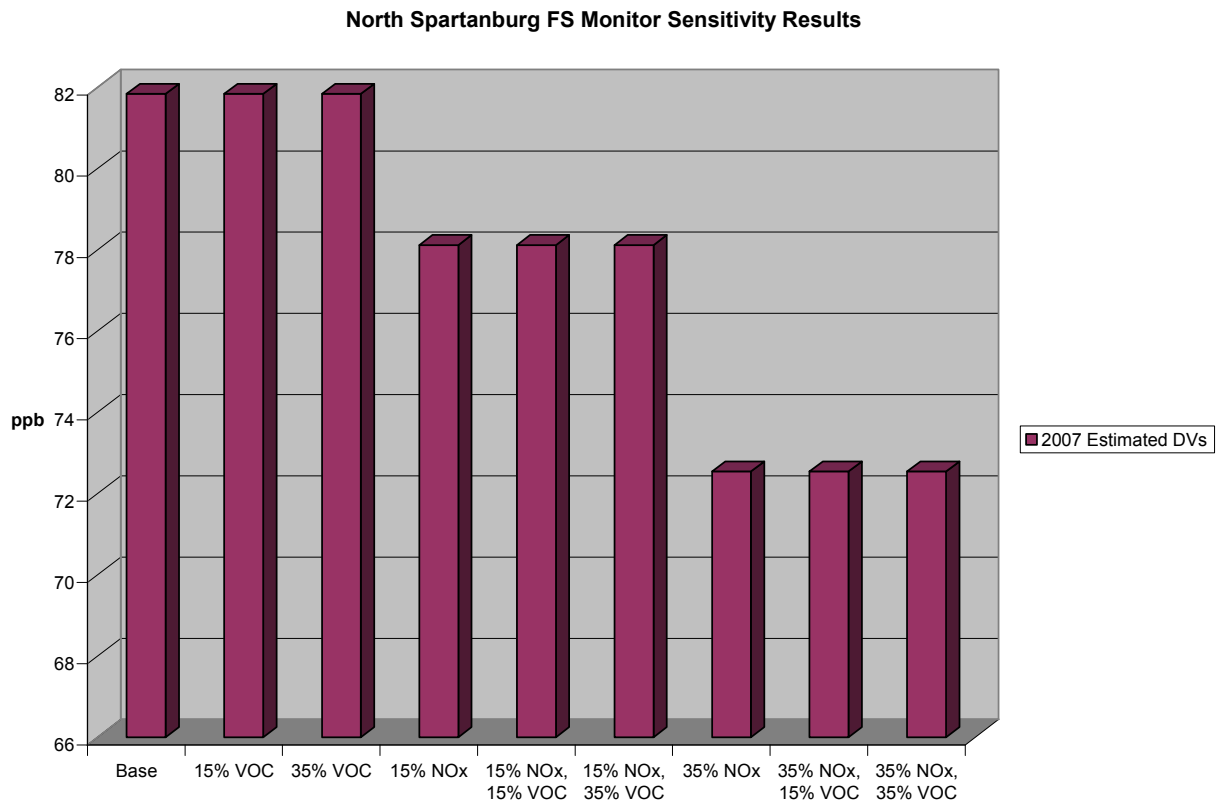
Powdersville Monitor Sensitivity Results

Figure ES-5a. Anderson area sensitivity results.

North Spartanburg FS Monitor Sensitivity Results

Figure ES-5b. Spartanburg area sensitivity results.

Sandhill Monitor Sensitivity Results
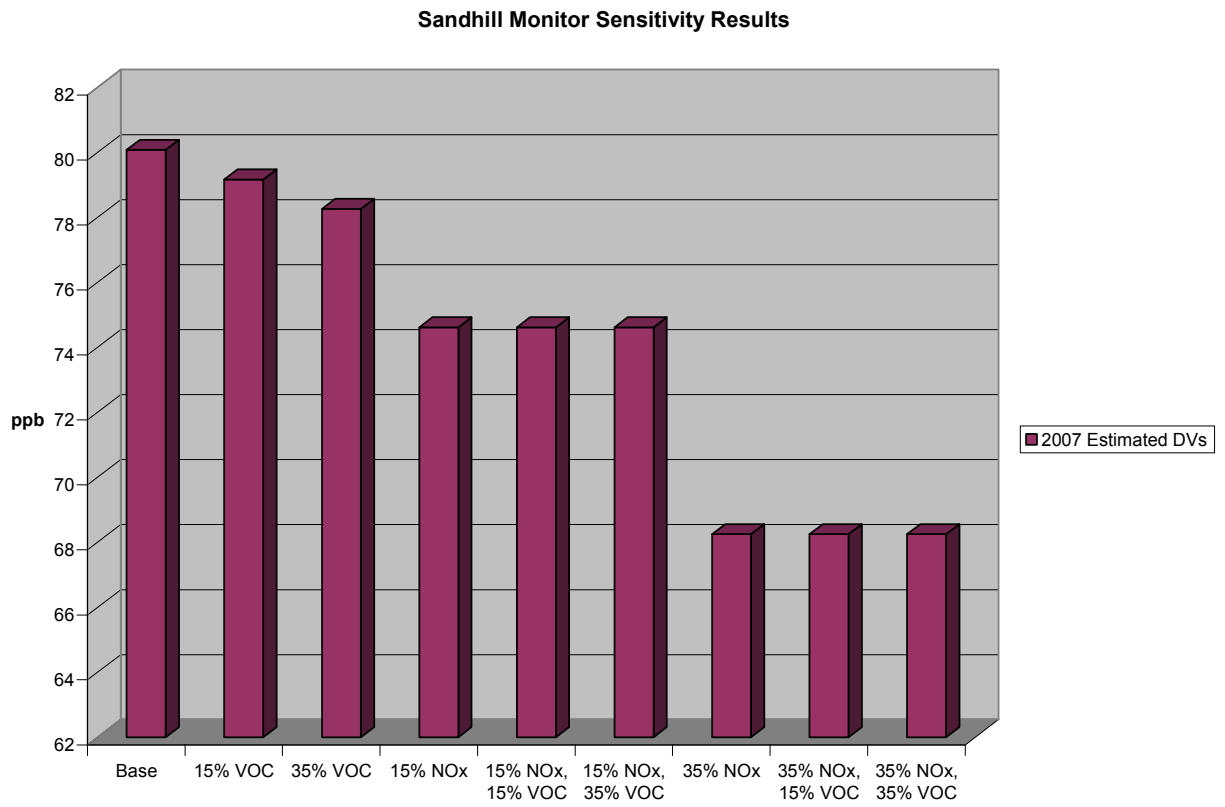
Figure ES-5c. Columbia area sensitivity results.

Jackson Monitor Sensitivity Results
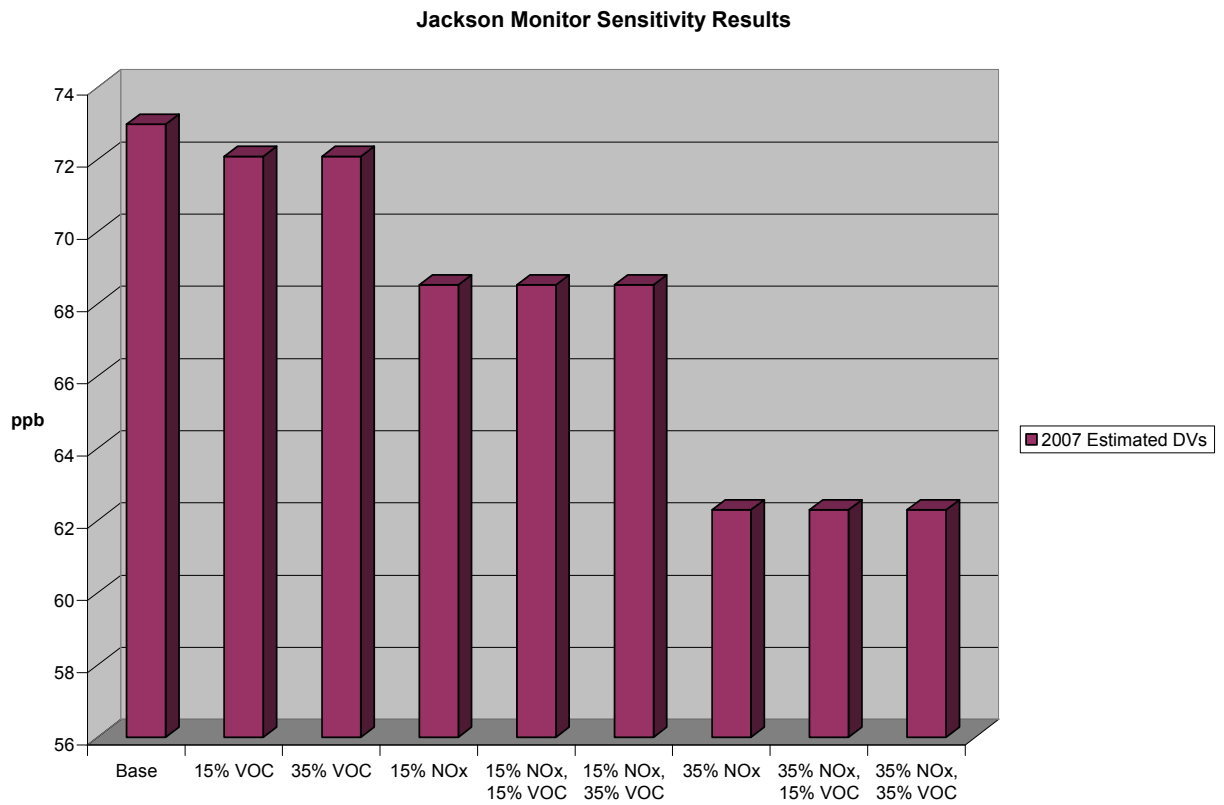
Figure ES-5d. Aiken-Augusta area sensitivity results.

York Monitor Sensitivity Results

Figure ES-5e. York area sensitivity results.

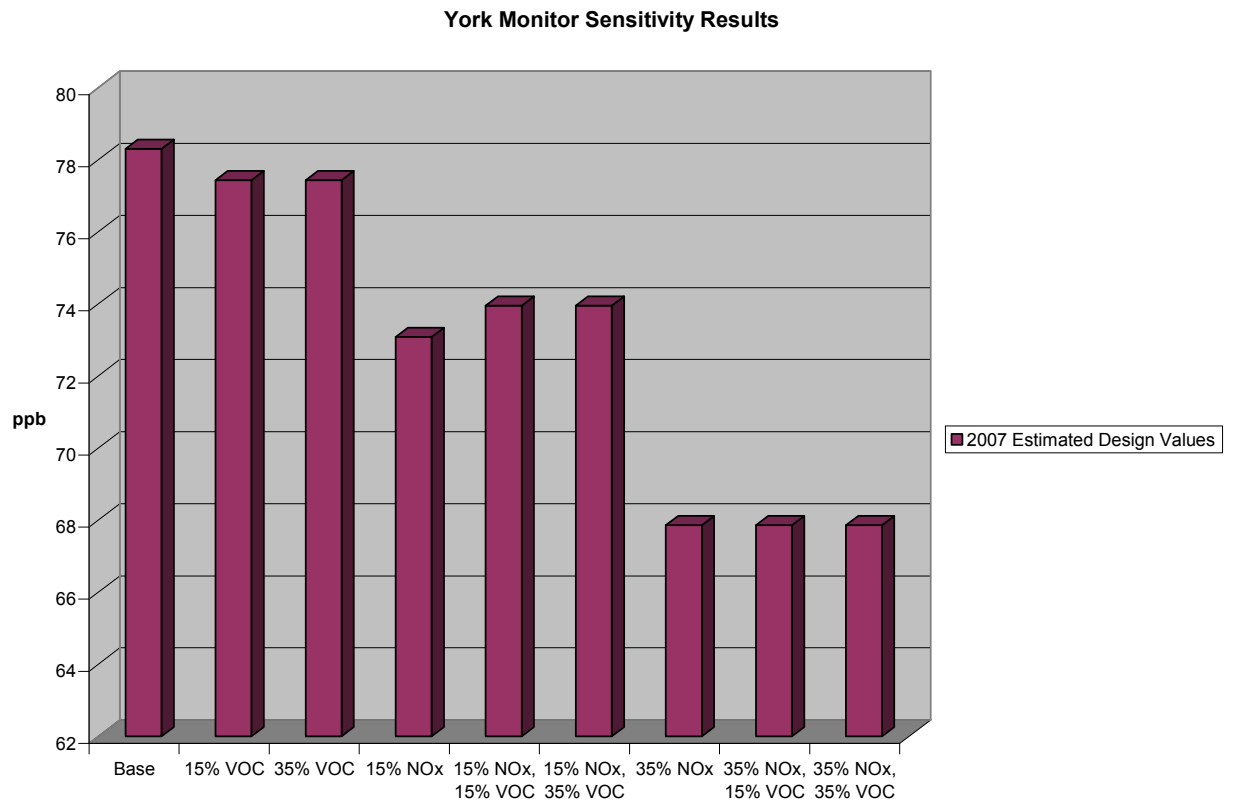**Army Reserve Monitor Sensitivity Results**

Figure ES-5f. Charleston area sensitivity results

SUMMARY

A state of the art ozone modeling analysis was performed to support South Carolina's efforts in the early action compact process. The results of the analysis are considered to be technically credible. The attainment tests indicate South Carolina can attain the 8-hour ozone standard by 2007 through the implementation of Clean Air Act controls alone. The attainment tests also show South Carolina will continue to be in attainment in 2012 and 2017. Sensitivity runs indicate the South Carolina region is NO_x limited. Additional reductions of NO_x emissions through state and local control measures will be directionally sound.